

MAGNT RESEARCH REPORT No. 2
September 1998

**REPORT ON THE 'KURINELLI METEORITE',
NORTHERN TERRITORY, WITH REFERENCE
TO THE *METEORITES ACT* 1988**

DIRK MEGIRIAN



Museums and Art Galleries of the Northern Territory

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REPORT ON THE 'KURINELLI METEORITE', NORTHERN TERRITORY, WITH REFERENCE TO THE *METEORITES ACT 1988*

DIRK MEGIRIAN

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INTRODUCTION

Meteorites found after 15 June 1988 are protected in the Northern Territory under the *Meteorites Act*, 1988, which is administered by the Museums and Art Galleries Board (MAGB) of the Northern Territory. This report summarises and unites currently available information on a new iron meteorite, an octahedrite now almost completely oxidised, found in the course of gold prospecting on the Kurinelli goldfield, centred about 150 km southeast of Tennant Creek (Fig. 1), and leads to some recommendations for further action by the MAGB.

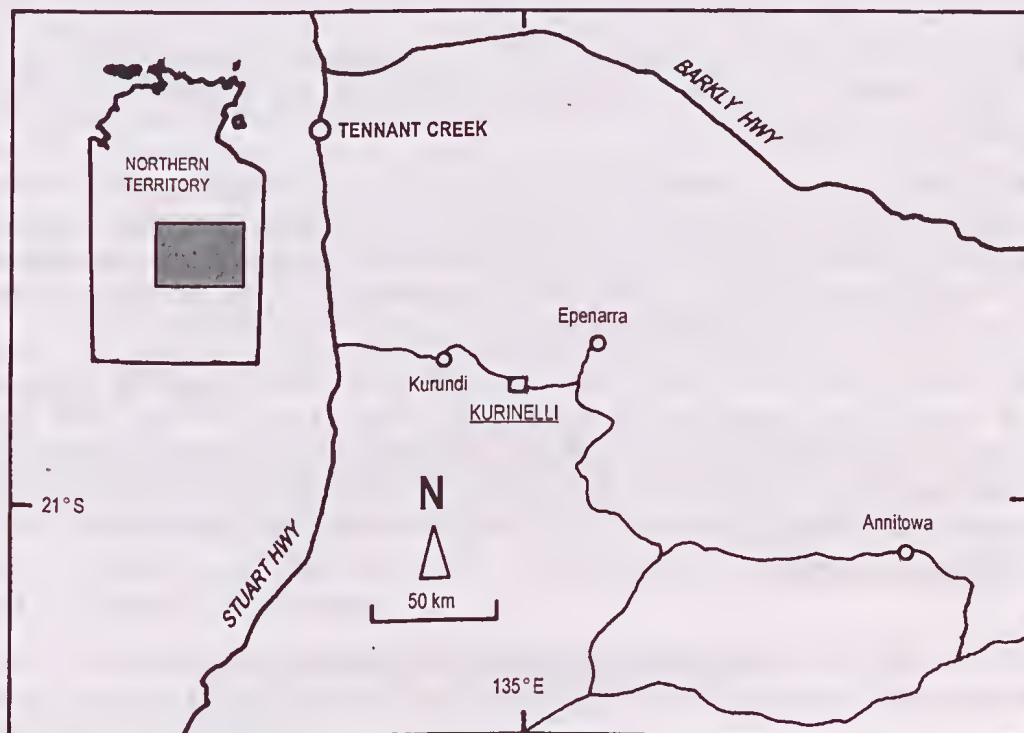


Fig. 1. Locality diagram.

Attached to this report is informative correspondence between various parties interested in the find, for the most part made available by Mr Peter Simpson, Exploration Manager for Giants Reef Mining NL (GRM). Peter Simpson was instrumental in bringing the find to the attention of the Museums and Art Galleries of the Northern Territory (MAGNT), and has played a major role in furthering investigations of the discovery (Attachments 1-7).

Most current activity on the Kurinelli goldfield revolves around prospecting by individuals, sometimes in partnerships, using metal detectors to search for gold nuggets. Heavy machinery (graders and bull-dozers) may be employed to strip off overburden, thereby bringing more deeply buried nuggets within detection range. Meteorite fragments produce a strong signal on metal detectors, much like gold nuggets, though some prospectors interviewed claim they can now distinguish the signals. The meteorite fragments are referred to in the vernacular of the goldfield as 'hot rocks'.

Unbroken fragments of the new meteorite typically have blocky shapes with irregular, rounded-off surfaces. The outer weathered surfaces have brown (Munsell 5YR 3/4 to 5YR 2/2) and reddish brown (10R 4/6 to 10R 3/4) hues, and are typically highly polished. In these characters they resemble desert-varnished rocks of the arid interior. Internally, they are lustrous dark grey (N3) to greyish black (N2), veined by brown and reddish brown. The mineralogy is dominated by oxidised compounds of iron (hematite, magnetite, maghemite, goethite, limonite) with traces of chromite and quartz, and rare iron-nickel alloy (Attachments 1, 2 and 7). Five lots of Kurinelli material, including polished and thin-sections used in analyses given in the attachments, lodged with the MAGNT are listed and briefly described below.

The composition includes about 4% nickel (Attachment 4), which is ore-grade for that metal. However, the absence of ultramafic strata in the region, and clear petrographic evidence for a meteoritic origin in the form of relict Widmanstätten textures (in spite of the highly weathered state of the specimens) discourages any notions that a nickel prospect exists at Kurinelli.

Details of the discovery, proposing that the new find be formally recognised as the Kurinelli meteorite will be forwarded by Dr Alex Bevan (Western Australian Museum) to the Nomenclature Committee of the Meteoritical Society, which acts a governing body for the naming of new meteorites (Attachment 5). (The activities of the Meteoritical Society are reported in its journal *Meteoritics and Planetary Sciences*.)

A brief visit was made to Tennant Creek and Kurinelli by MAGNT staff, D. Megirian and P. Murray, in the company of Peter Simpson, between 11 and 14 May, 1998. The object was to make direct contact with some of the finders, and to make an assessment of what future work might be carried out by MAGNT in order to best meet the objectives of the Meteorites Act 1988. Results of this visit are summarised below in the list of MAGNT material.

LIST OF ATTACHMENTS

1. Copy of petrographic analysis (30 October 1996) carried out by N.J.W. Croxford (Rockco Pty Ltd) for Peter Simpson (GRM)

2. Copy of petrographic and geochemical analyses (5 and 12 November 1996) carried out by Amdel for the Northern Territory Department of Mines and Energy.
3. Copy of petrographic, minerographic and SEM descriptions carried out by J.E. Borner (Mintek Services) for Giants Reef Mining.
4. Copy of letter (28 May 1997) from Peter Simpson (GRM) to Alex Bevan (WAM), detailing background to the find.
5. Copy of letter (25 June, 1977) from Alex Bevan (WAM) to Peter Simpson (GRM), proposing formal announcement of a new meteorite.
6. Copy of letter (10 October 1997) from Peter Simpson (GRM) to D. Megirian (MAGNT), donating specimen (MAGNT 9860) on behalf of Tony Campbell, and providing new information supplementary to Attachment 4.
7. Copy of letter (31 May 1998) from Peter Simpson (GRM) to D. Megirian (MAGNT) covering donation of thin-sections (MAGNT 9866) and analysis based on these sections carried out by Roger Townend and Associates (1 May 1998).

LIST OF MAGNT KURINELLI METEORITE SPECIMENS AND SUPPLEMENTARY INFORMATION

9860 - 129.4 g sawn slab from a larger mass collected and donated (via Peter Simpson) by Mr Tony Campbell.

9861 - ca. 415 g broken fragments, collected and donated by Mr John McDonald of Tennant Creek, who prospects at Kurinelli. John McDonald advised that an associate of his, Mr Ray Hall has found and/or accumulated a considerable amount of material. Ray Hall lives in Victoria, and thus there was no opportunity to meet with him. The fragments donated by John McDonald are broken quite finely. Peter Simpson explained that these would have been smashed to see whether gold was present in the interior: gold from the Tennant Creek and Kurinelli goldfields often occurs in ironstone, some forms of which may appear very similar to weathered meteoritic material, and consequently were thoroughly investigated before finders became more familiar with the material. John McDonald indicated that material is widespread at Kurinelli, though not evenly distributed: i.e. there are areas in which it occurs at higher frequency.

9862 - ca. 610 g sawn mass donated by Peter Simpson: material collected by Tony Campbell (see 9860).

9863 - ca. 1.8 kg of assorted fragments, some sawn, donated by Mr Colin Wessel, a resident miner at Kurinelli (GPS at Wessel's residence: 20°37'55"S, 135°04'38"E). Mr Wessel advised that all the specimens were collected on his tenement.

9866 - 1 polished and 1 thin section; the subject of analyses detailed in Attachments 3 and 7. Donated by Peter Simpson.

One of the more intriguing pieces of information that emerged came from Mr Peter Saint, owner of Kurundi Station, who reported that meteoritic material has also been found as far from Kurinelli as Annitowa (Fig. 1).

No signs of an impact structure could be discerned at Kurinelli, nor are we able at this stage to identify any specific geomorphological controls on the distribution of

meteorite fragments. All people we were able to interview reported that the material occurs in the soil profile rather than at the surface, suggesting that the fall is of considerable antiquity.

DISCUSSION

Most of the material now held in the MAGNT is fragmentary, and for the most part adequate locality data are not available. As previously mentioned, mining tenement holders at Kurinelli may work a particular area in a partnership, so it cannot be assumed that any particular specimen comes from a tenement held by the collector. Furthermore, the material was not collected by the finders with meteoritical research in mind, and consequently collection data is minimal.

Further investigation into the distribution of meteorite fragments, including verification of Peter Saint's report that fragments have been found well beyond the Kurinelli goldfield, is warranted. It is through such information that the extent of the original fall, and/or the factors controlling its present terrestrial distribution might be elucidated. Specimens whose provenance is adequately documented are essential.

Apparently quite large masses have been found, but all the material now held MAGNT is either small, sawn, or smashed. Large intact masses could be invaluable in some investigations, such as, for example, research into terrestrial weathering rates (Attachment 5).

No evidence has come light that pieces of Kurinelli were found before 1988: the earliest recorded finds were probably made in 1996. Thus, the indications are that all fragments of Kurinelli are the property of the Northern Territory. Fossicking for meteorites is not permitted under the *Meteorites Act* 1988, and any meteorites found in the course of fossicking for other minerals after 1988 may be held privately only for the purpose of passing them on to the MAGB in the shortest practical time. However, it must be recognised that there exists a long-established trade and popular interest in Northern Territory meteorites, mostly involving Henbury, innumerable fragments of which were lawfully collected prior to 1988. Lawfully collected fragments may be freely traded and/or exported from the Northern Territory, though their export overseas from Australia requires a permit under the Commonwealth *Movable Cultural Heritage Act*. Thus, there exists an established network by which new meteorites are brought onto the market, probably mostly in ignorance of current law.

The current MAGB strategy on meteorites covered by the *Meteorites Act* largely revolves around a public awareness program of the scientific importance of meteorites and the role of the MAGNT in their preservation for posterity, investigation of reported finds, and liaison with regulatory and research organisations and interested members of the public. It may turn out that large quantities of Kurinelli exist, and attempting to acquire every specimen is neither practical nor necessary to satisfactorily achieve the objectives of the *Meteorites Act*. Monitoring of the situation is essential, and some level of private ownership may be tolerable provided the objectives of the *Meteorites Act* are not compromised or undermined.

The primary objective of the MAGNT should be to gain an overview of the distribution, quantities, modes of occurrence and preservation of Kurinelli meteorite.

Voucher specimens supported by good collection data will provide the necessary baseline information on this new find.

Prospectors and others working in and around Kurinelli have already made significant contributions, and should be encouraged to continue to assist in these endeavours until MAGNT can be reasonably confident that most of the potentially useful scientific information has been recovered.

MEMORANDUM

MEMO TO: Peter Simpson

MEMO FROM: N J W Croxford
Rockco Pty Ltd

SUBJECT: Identity of an iron-rich field specimen

DATE: 30 October 1996

Two polished thin sections were prepared and the following observations made, viz.,

1. The iron oxide goethite, FeO.OH is abundant. It might be derived from the iron sulphide troilite¹ although no relict troilite was found.
2. Well crystalline magnetite (\pm martitic haematite) occurs.
3. Maghemite $-\text{Fe}_2\text{O}_3$ is common and interbanded with the other components. It is recognisable in polished section by its bluish colour compared to other Fe-oxides. The maghemite probably accounts largely for the high magnetic susceptibility.

Maghemite could form from primary magnetite and/or secondary magnetite derived from troilite.

4. Native iron as isolated, small grains and patches of small grains. Relict textures indicate iron residuals came from larger, well formed iron crystals (see plates).
5. Some lepidocrocite probably occurs but this needs confirmation.
6. Very minor quartz accompanies the goethite. I suggest this is weathering silica introduced into the specimen.

This specimen is unlike anything I have examined previously. Also, metallic iron is rather rare in terrestrial rocks, although Dana (1966, p.408) reports 'earthly' iron as

"Found in masses, occasionally of great size, as well as in small imbedded particles, in basalt at Blaafeld, Ovifak, Disco Island, West Greenland; also elsewhere on the same coast. This iron contains 1-2 percent of Ni".

¹ Stoichiometric FeS and peculiar to meteorites.

Peter Simpson

2

Subject: Identity of an iron-rich field specimen

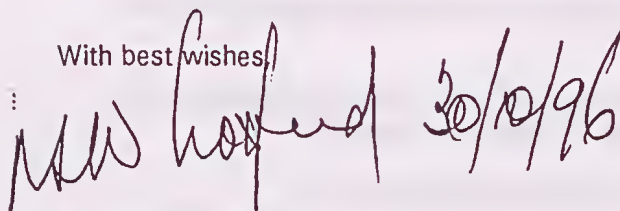
Dana mentions several other native iron occurrences and concludes that,

"some other occurrences usually classed as meteoric, may be in fact terrestrial".

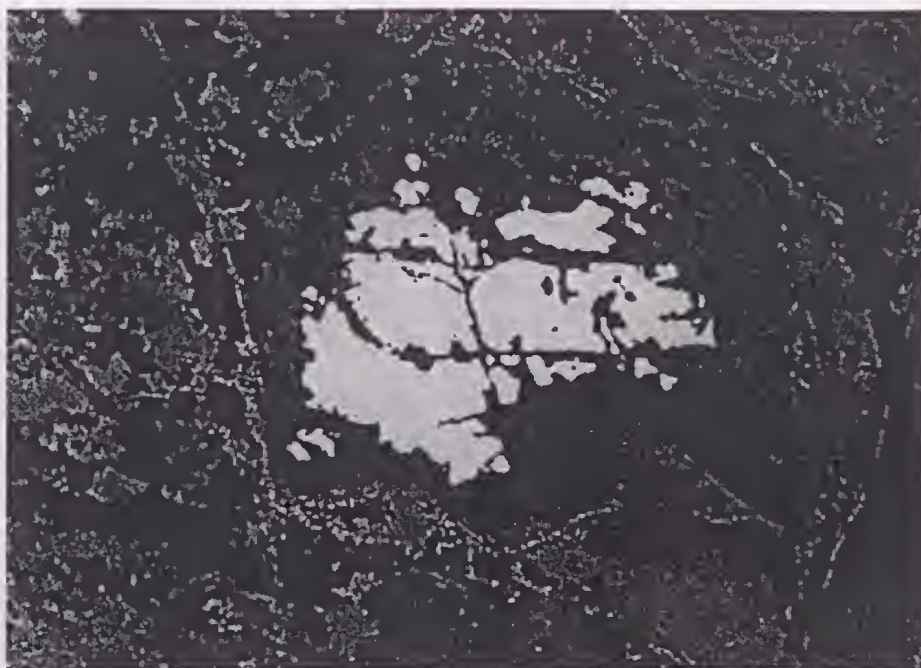
This specimen could be a meteorite (troilite-magnetite-native iron). Conceivably being it could be of igneous derivation considering Dana's comments regarding iron and basalts; and the occurrence of dolerite dykes in the area concerned.

Please bear in mind my lack of expertise in this field.

With best wishes,

A handwritten signature in dark ink, appearing to read 'N J W Croxford', followed by the date '30/10/96' written in a similar cursive style.

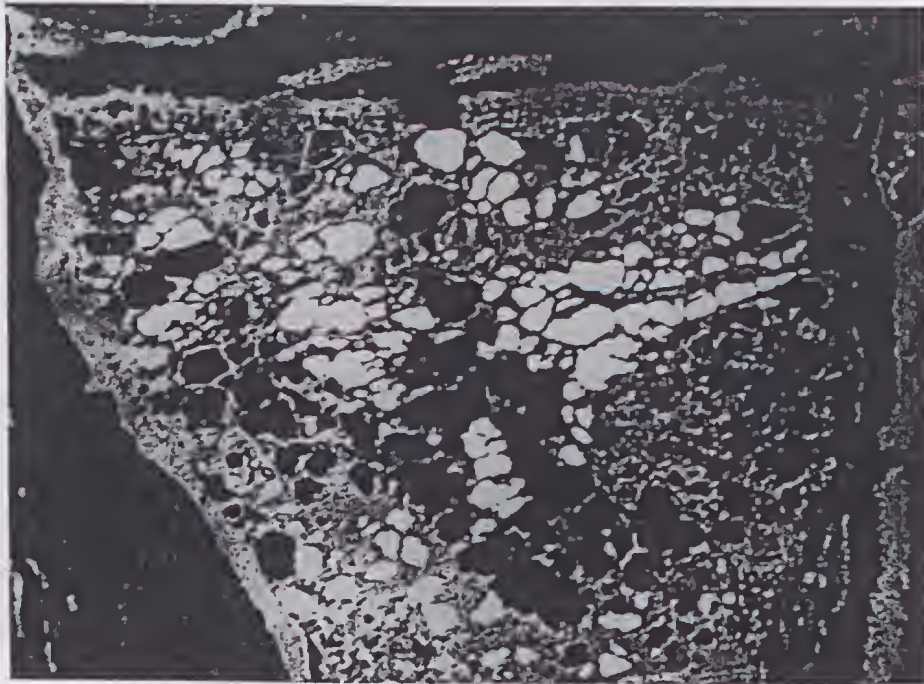
N J W CROXFORD



50 μ m

PLATE 1: IRON-RICH SPECIMEN (X500/RPPL/OIL)

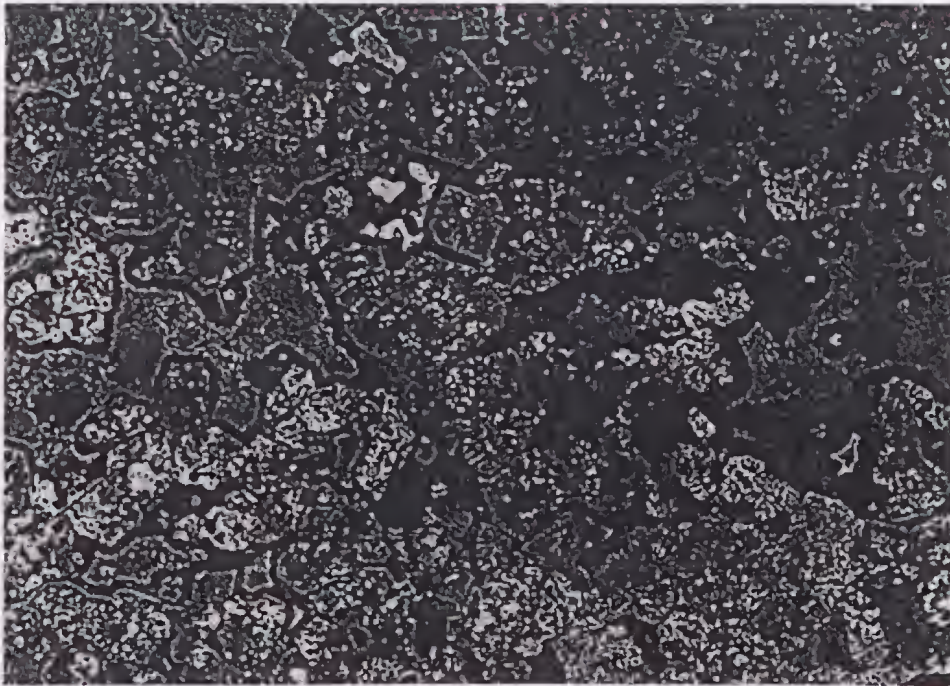
A relict area of metallic iron (white) lies in a groundmass of various iron oxides. Arrows outline the possible limits of the original iron crystal.



50 μ m

PLATE 2: IRON-RICH SPECIMEN (X500/RPPL/OIL)

Grains of metallic iron (white) rest in a groundmass of magnetite, maghemite and limonite. The black areas are plucked out iron particles.



50µm

PLATE 3: IRON-RICH SPECIMEN (X500/RPPL/OIL)

Clustered, subhedral to euhedral magnetite crystals are altering to maghemite and haematite. The dark grey interstitial filling is goethite.



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5 November 1996

Northern Territory Department of Mines and Energy
GPO Box 2901
DARWIN NT 0801

Attn: John Canaris

REPORT G657800G/96

PETROGRAPHY OF ONE ROCK

YOUR REFERENCE:	Letter dated 16 October 1996
SAMPLE IDENTIFICATION:	MCC1020-A
MATERIAL:	Rock
LOCATION:	XXXXXXXXXX Kurinelli NT
DATE SAMPLES RECEIVED:	22 October 1996
DATE AUTHORISATION RECEIVED:	22 October 1996
WORK REQUIRED:	Petrography and electron-probe microanalysis
INVESTIGATION AND REPORT BY:	Dr Graeme Watmuff
ELECTRON-PROBE MICROANALYSIS BY:	Dr Peter K Schultz

Dr Keith J Henley
Manager, Mineralogical Services

db

The results contained in this report relate only to the sample(s) submitted for testing.
Amdel Limited accepts no responsibilities for the representivity of the sample(s) submitted.



Northern Territory Department of Mines and Energy

2

SAMPLE: MCC 1020-A: PTS C67139

ROCK NAME: Oxidised iron meteorite

HAND SPECIMEN:

This is a hard, fine-grained, massive steely-grey rock with a very fine, subtle, laminar structure. Broken surfaces have a vitreous lustre and cut surfaces reveal the presence of an irregular network of fine fractures less than 0.5 mm wide commonly filled or partly filled with grey-red (?) ochre. A single, irregular, locally bifurcating fracture about 3 mm wide and carrying similar material to the finer fractures also cuts across the rock. The sample is noticeably magnetic.

POLISHED SECTION:

An optical estimate of the constituent minerals is as follows:

Mineral	%	Origin
Hematite	60	Supergene
Goethite	40	Supergene
Chromite	Trace	Primary
Quartz	Trace	Supergene
Fe - Ni alloy	Rare	Primary

This is a massive hematite-goethite rock with minor secondary quartz and traces of relict iron-nickel alloy and chromite.

The fine subtle laminar structure noted in hand specimen relates to a probable boxwork structure in hematite and minor goethite possibly reflecting a dominant cleavage direction in the crystal structure of the pre-existing mineralogy. It is defined by slightly wavy <0.01 mm wide parallel strands of smooth to earthy hematite, commonly alternating with minor similarly wide discontinuous strands of goethite. The direction of this fine structure is fairly consistent across the slide, although there appears to be some slight rotation between cm sized domains.

A much coarser rectangular to rhombic boxwork structure is imposed upon the fine structure and is defined by 0.01 to 0.03 mm wide cell walls of layered hematite/goethite 0.05 to 1 mm apart. One side of the cells is parallel to the finer structure described above. The cells are generally filled with varying proportions of massive, usually finely mixed, earthy and locally porous hematite and goethite. A few <0.1 mm sized ragged remnants of iron-nickel alloy engulfed by goethite are patchily disseminated throughout.

At low magnification, the alloy has a colour and reflectivity similar to pyrrhotite, but at very high magnification it appears to consist of brighter material densely sieved with sub-micron sized grey spots giving the surface a rough or earthy texture. It also appears to be softer than the enclosing goethite. The low electron-probe microanalysis totals may reflect this surface roughness and/or a possible carbon content.



A single elongate crystal of chromite about 0.6 mm long bounded entirely by euhedral faces is embedded in the hematite-goethite matrix of the rock. It is crazed by a network of stepped fractures filled with films of hematite and goethite and contains an elongate rounded bleb of earthy hematite-goethite, probably after an original alloy inclusion.

The fractures noted in hand specimen are lined with layers of colloform and botryoidal goethite with minor thin hematite layers. Central cavities are mostly filled with a sutured mosaic of granular quartz/chalcedony commonly showing radiating optical extinction. One 1 cm wide cavity is filled with massive porous earthy goethite and minor hematite.

This rock most probably an oxidised iron meteorite. The presence of traces of iron-nickel alloy and probably generally high Ni content of the hematite and goethite in the rock (Table 1) strongly suggest that the entire sample apart from trace chromite was an iron-nickel alloy with trace cobalt. An X-ray diffraction scan of the polished section off-cut revealed the presence of minor possible maghemite which may explain the magnetic character of the hand specimen.

TABLE 1: *ELECTRON-PROBE MICRO-ANALYSES OF SELECTED METAL AND OXIDE PHASES IN THE UNLABELLED IRONSTONE

Element determined (%)					
Metal Alloy					
Fe	Ni	Co	Cu	S	Total
89.4	7.1	0.25	0.06	0.0	96.8
90.2	7.0	0.25	0.00	0.0	97.5
89.2	7.1	0.26	0.01	0.0	96.6
Chromite					
Fe	Ni	Co	Cu	S	Total
18.7	0.07	0.01	0.00	0.0	18.8
Hematite in hematite/goethite inclusion in chromite					
Fe	Ni	Co	Cu	S	Total
52.6	7.9	0.13	0.02	0.0	60.6
Hematite (random point)					
Fe	Ni	Co	Cu	S	Total
55.4	5.9	0.18	0.01	0.0	61.5
Goethite (random point)					
Fe	Ni	Co	Cu	S	Total
47.9	3.7	0.16	0.00	0.1	51.8

*Cameca electron probe in wavelength-dispersive mode at an accelerating voltage of 20 kV and a beam current of 20 nA. Peak counting times of 10 seconds and two background counting times of 5 seconds were used for each element giving approximate detection limits of 0.1%. The following standards were used: pyrite, nickel, copper and cobalt.



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12 November 1996

Northern Territory Department
of Mines and Energy
GPO Box 2901
DARWIN NT 0801

Attn: John Canaris

REPORT G660000G/96**PETROGRAPHY OF AN IRONSTONE SAMPLE**

YOUR REFERENCE:	Fax dated 4 November 1996
SAMPLE IDENTIFICATION:	MCC 1020-A
MATERIAL:	Rock <i>Kurinelli NT</i>
LOCATION:	XXXXXXXXXXXX
DATE SAMPLES RECEIVED:	22 October 1996
DATE AUTHORISATION RECEIVED:	7 November 1996
WORK REQUIRED:	Petrography (Code PET 3.2.1)
INVESTIGATION AND REPORT BY:	Dr Graeme Watmuff

Keith Henley

Dr Keith J Henley
Manager, Mineralogical Services

GW/msm1

*The results contained in this report relate only to the sample(s) submitted for testing.
Amdel Limited accepts no responsibilities for the representivity of the sample(s) submitted.*



Northern Territory Department of Mines & Energy

1

PETROGRAPHY OF AN IRONSTONE SAMPLE

1. INTRODUCTION

It was requested by John Canaris of the Northern Territory Department of Mines and Energy in a telephone conversation on 7 November 1996, that a petrographic description of a second slice from the unlabelled ironstone, now numbered MCC 1020-A, be carried out. The sample initially received was an approximately 6mm thick 50 x 50mm slab. This had been cut into two 25 x 50mm pieces and a polished thin section was prepared from the 25 x 50mm piece designated by the client. The petrographic description was given in Report G657800G/96.

2. PROCEDURE

A polished thin section was prepared from the 25 x 50mm piece not previously sectioned and examined in reflected and transmitted polarized light using a petrographic microscope. This polished thin section carried a 5mm wide bifurcating vein-like structure not apparent in the section offcut, indicating short, three dimensional structural variation in the sample. This structure was noted in the hand specimen description of the first petrographic description, as this related to both 25 x 50mm pieces.

3. RESULTS

This appears to have been be a massive magnetite rock cut by magnetite veins. It contained traces at least of interstitial Fe-Ni alloy and it appears to have been substantially oxidized to secondary hematite, maghemite and goethite. Possibly two relict native metals are present, a harder white phase and a softer yellower phase, but this would require electron-probe microanalysis to confirm and identify. The origin of this rock is uncertain. Meteoritic iron typically has a Ni content between 5 and 15%; however, terrestrial irons are known to fall in this range also. Terrestrial native iron is known to occur in basalt, e.g., Disko Island, Greenland where pieces as large as 20 tons have been located. This iron commonly manifests meteoritic iron textures. Terrestrial native iron is also known to occur with magnetite in granite at Ben Bhreck, Scotland.

4. RECOMMENDATIONS FOR FURTHER WORK

- (1) Electron-probe microanalysis to determine the distribution of Ni in the various oxide phases identified. The high bulk nickel content of the rock is puzzling in view of the probable low original metallic iron content. Magnetite does not normally contain much nickel.
- (2) Electron-probe microanalysis of the metallic phases.
- (3) Photomicrography to establish a pictorial record of textures found in the various samples submitted.

Report G660000G/96

12 November 1996



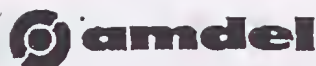
Northern Territory Department of Mines & Energy

2

- (4) Petrography on fresher samples including the dolerite sill and basal ultramafic to see if ironstone textures relate in any way to the silicate mineralogy of the potential host rock.

5. PETROGRAPHY

A petrographic description of the second polished thin section of MCC 1020-A is given below:



Northern Territory Department of Mines & Energy

3

SAMPLE: MCC 1020A : PTS C67152

ROCK NAME: Ironstone

HAND SPECIMEN:

This is a highly magnetic steely-grey rock with a subtle fine laminar texture, cut by irregular mm wide fractures filled with locally porous orange-brown oxide. The area in the offcut coinciding with the bifurcating vein structure referred to above has broadened into a 2cm wide breccia-like zone, consisting of steely-grey material mingled with porous orange-brown oxide.

POLISHED SECTION:

An optical estimate of the constituent minerals is as follows:

Mineral	%	Origin
Maghemite/hematite	80	Supergene
Magnetite	10	Primary
Goethite	10	Supergene
White native metal	Rare	Primary
(?) Yellow white native metal	Rare	Primary

This is a massive maghemite, hematite, magnetite and goethite rock with rare metal alloy. The fine laminar texture noted in hand specimen is due to parallel, slightly wavy, mostly <0.05mm wide and commonly anastomosing, alternating strands and lenses of hematite, maghemite, magnetite and minor goethite. These strands are mostly closely bunched, but there are areas of massive magnetite up to 5mm across where the strands are only sparsely developed. This massive magnetite locally shows patchy, commonly micro-fracture controlled replacement by maghemite and hematite. Elsewhere it has suffered massive replacement by massive to earthy goethite and massive maghemite leaving a few magnetite relicts with diffuse grain boundaries. Also the areas of maghemite after magnetite locally show an internal granular structure, outlined by a chickenwire mesh of hematite and/or goethite suggesting that at least some of the massive magnetite is in fact a tightly compacted mass of 0.03 to 0.1mm sized granules. Similar textures are preserved in massive and earthy goethite.

Cutting across the fine laminar structure of the rock are relatively widely spaced subparallel cross fractures 0.05 to 0.6mm apart, filled with films of goethite and slivers of hematite <0.02mm wide. These produce the cellular boxwork structure described in the first petrographic description (Report G657800G/96). The fractures visible in hand specimen filled or partly filled with orange-brown oxide generally run parallel to this cross fracture direction; however, they also commonly diverge to cut the fine laminar structure at a low angle or even run subparallel to the laminar structure. The wider fractures are commonly filled and/or lined with fairly closely packed idiomorphic magnetite crystals, embedded in porous commonly acicular, goethite. The magnetite is usually extensively altered to porous goethite, usually in the grain cores, leaving magnetite atolls with cubedral outlines laced with crystallographically controlled plates of hematite. Central cavities in the veins are filled or partly filled with

Mintek
Services



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15 May 1997

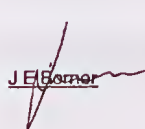
Mr Nick Byrne
Managing Director
Giants Reef Mining NL
PO Box 1244
TENNANT CREEK NT 0861

Petrographic · Mineragraphic · SEM Report

Sample Number

0531

Facsimile 16 October 1996

 M. A. [unclear]

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• Geology • Petrology • Mineralogy • Mineragraphy •

MINTEK SERVICES

PETROGRAPHIC · MINERAGRAPHIC · SEM DESCRIPTION

Report No. 39046
 Sample No. 0531 GIANTSREEFMining
 Thin Section and Polished Section

STEREOSCOPIC CHARACTERISTICS

Field Name: Unidentified ironstone.
 Nature of Sample: Ferruginous rock sample.
 Minerals Visible: Goethite and/or hematite (martite), maghemite and silicate minerals.
 Texture: Massive and granular.
 Colour: Dark brown, reddish brown and brown, rarely tan.
 Grain Size: Very fine and fine grained.
 Other Comments: This strongly ferromagnetic, ferruginous rock appears under a binocular microscope to be predominantly composed of very fine interlocking hematite (martite) and minor goethite aggregates that exhibit no diagnostic relic igneous textures. Magnetite oxidizes readily to martite and titanomagnetite to titanomartite or titanomaghemite. Fresh magnetite appears to be absent. Relic sulphide textures are not exposed in intergranular sites as boxwork or sponge textures.

MICROSCOPIC CHARACTERISTICS

Constituents: (Percent visual estimate)

- 32% Clay group minerals of indeterminate composition, probably mainly kaolinite and montmorillonite, occur as finely matted aggregates that exhibit what appear to be the relic bladed textures and reticulated textures of a quenched or chilled silicate melt, possibly derived from a shattered, stony iron meteorite. The clay group minerals have been stained and masked by exotic (transported) goethite and hematite aggregates derived from oxidized magnetite and titanomagnetite. Residual serpentine group minerals, talc, chlorite, carbonate and amphibole or pyroxene group minerals are not exposed in interstitial or intergranular sites.
- 8% Quartz occurs as cryptocrystalline mosaic textured aggregates sited in what appear to be fine leach cavities, hence a surficial origin is suspected. It is encapsulated by the dominant, ferruginized, clay group minerals. Relic clastic textures are absent.
- 32% Indigenous martite (hematite) occurs abundantly as fine interlocking aggregates with a massive fabric that appear to have replaced massive magnetite containing appreciable Ti, Mn and Ni values. This chemical composition is very unusual for terrestrial magnetite occurrences, hence a meteoritic origin is suggested for this ironstone. Fresh magnetite and titanomagnetite are absent.
- 28% Exotic goethite and hematite occur as patchy granular aggregates locked in hematite and clay minerals that exhibit a fine reticulated fabric.

-2-

Sample No. 0531 GIANTSREEFMING
Thin Section and Polished Section

Texture: Massive, matted and reticulated (fine bladed).
Surficial Alteration: Weathering and oxidation.
Metasomatic Alteration: None exposed.

Morphology: Massive martitized magnetite with abundant clay minerals and minor quartz in probably non-terrestrial ironstone (?meteorite).

Remarks: There are no diagnostic relic igneous textures, including cumulate (ad-cumulate and mesocumulate) textures, exposed to suggest that the protolith was an ultramafic with a lithology like a peridotite, harzburgite or olivine pyroxenite showing relic quench or spinifex textures as seen in all ultramafic komatiites. A stony iron meteorite is suggested as a precursor. Nickel-iron could have been an important opaque mineral component present prior to surficial oxidation to martite and goethite. The SEM scan detected no residual metallic iron or native nickel-iron inclusions.

ROCK NAME: MASSIVE MARTITIZED MAGNETITE WITH ABUNDANT CLAY MINERALS
AND MINOR QUARTZ
IN PROBABLY NON-TERRESTRIAL IRONSTONE (?METEORITE)

**GIANTS REEF MINING N.L.**

A.C.N. 058 436 794

28 May 1997

Dr Alex Bevan
Curator of Mineralogy and Meteorites
Western Australian Museum
Francis Street
PERTH WA 6000

1/26 IRVINE STREET
TENNANT CREEK NT 0860

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Dear Dr Bevan,

RE: KURINELLI (NT) METEORITE FRAGMENTS

I refer to your letter dated 2 February 1997 to Messrs. J Gresham and B Green of Wiluna Mines concerning the specimen of suspected meteorite that your assistant Mr Peter Downes examined. Through our joint venture in the Tennant Creek region with Wiluna Mines I received a copy of the letter.

As you requested information about the meteorite in your letter, I am writing to provide a little background to the find.

The Kurinelli goldfield is on Kurundi cattle station, centred about 135°03'E 20°37'S (Hatches Creek 1:100 000 series sheet no. 5956: part of the Frew River 1:250 000 sheet SF53-3). The goldfield has not been explored much by exploration companies, one reason being that the gold found there is all said to be very coarse and as such does not lend itself to accurate assessment by ordinary drilling. Other reasons are that the area is not very accessible, even by Northern Territory standards, and lacking in water for gold recovery methods requiring a lot of water. The field has long been the stronghold of semi-permanent prospectors who these days use metal detectors instead of dry blowing. They shave the surface with a small dozer a few times, then eventually spread all the pushed-up dirt back over the area and move on somewhere else. The goldfield is currently enclosed under a Section 15 Reserve imposed by the NT Government, which in effect leaves the field free for small operators.

The meteorite fragments first came to my attention late in September 1996, when Mr Ray Hall, one of the more entrepreneurial claim-holders in the field, approached our Managing Director, Mr Nick Byrne, (and other companies) with assay results from a nickel-rich specimen. The nickel content, around 4%, was of great interest, as were the precious metal levels, which were 2 ppm Au, 2 ppm Pd and 1.5 ppm Pt. Other metals were approximately 350 ppm Cu, ~200 ppm Mn and 0.18% Co. He gave us a specimen. Mr Byrne wondered at the time if it was a piece of a meteorite, from his previous experience with meteorite analyses in Western Australia during the Nickel Boom.

At first it was widely assumed that this must be a bedrock nickel occurrence and maybe one of great commercial potential. Our company sent men to do some field investigations,

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and as a small pegging rush began to develop, the NT Department of Mines and Energy, in particular the Director of Mines, Mr Tony McGill, took an active interest and sent a geologist (Mr John Canaris, now with World Geoscience Corporation in Perth) to report on the mode of occurrence of the nickel. In fact it was Mr McGill who, on a visit to the goldfield not long before, had suggested to Mr Hall that analysis for nickel and associated elements be done, as to him the Early Proterozoic geology of the area had some similarities with the greenstone belts of WA.

A piece of the chunk provided to us by Mr Hall was analysed with the following results:

3.19% Ni, 43.3% Fe, 0.16% Co, 96 ppm Co, 40 ppm Pb, 200 ppm Mn, 773 ppm S,
162 parts per billion Au, 1698 ppb Pt and 921 ppb Pd.

Geologists around Tennant Creek who had heard of these results, or similar results from other specimens that were analysed, also wondered if the specimens that were being handed around were in fact from a meteorite. One geologist, Mr John Love, looked up meteorite analyses published in "Meteorites and Their Origins" by GJH McCall, and these figures accorded well with the various metal abundances in the Kurinelli specimens. I sent a slice to a petrologist, Dr Bill Croxford in Brisbane, and the Department of Mines and Energy sent a piece to AMDEL in Adelaide. I enclose copies of their reports, which are a little equivocal but generally favour a meteorite origin.

Our company senior geologist, Mr John Fabray, hand-polished a face on one piece and the Widmanstätten structure was quite apparent.

It seems that the prospectors have been finding these pieces fairly often over the years. They call them "magnetic ironstone" and regard them as nuisances, as they give a signal (a "call", as they term it) on a metal detector, but when dug up, they are found to be just pieces of ironstone. When smashed open they still don't show any gold. There are lots of ferruginised surface rocks scattered in patches through the area, but the meteorite fragments can be recognised by their surface texture once you "get your eye in". They are not common, and it is possible to spend many hours searching without finding one. I do not know the size of the largest piece found, but I think that one of Mr Hall's specimens may have been a bit larger than half a brick.

I have in my office a 1:100 000 scale Landsat 5 TM false colour image of the Kurinelli goldfield and a 90 km x 90 km surrounding region. The image shows up the geology very clearly, but no-one who has examined it has been able to discern any feature that could plausibly be the ghost of an impact crater. Possibly the fragments being found at the goldfield are from an impact outside the area.

My own belief is that the Kurinelli Meteorite was a very ancient arrival, and that the impact crater(s) has long since been obliterated by erosion. This is in line with the advanced state of oxidation of the pieces, in which just enough metallic iron remains to give a response to a metal detector.

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People have remarked that it is rather a coincidence for these nickel and precious metal-bearing specimens to be turning up in a goldfield without them being somehow related to the known gold mineralisation there, and therefore they must have a terrestrial origin. However, the frequent turning over of the ground and the repeated scanning with metal detectors that has been done at Kurinelli might well produce similar quantities of meteorite "shrapnel" in many other parts of Australia if it were done with the same degree of intensity.

Enclosed is a slice of the meteorite, which I expect will show the Widmanstätten structure, if polished up.

I may be able to obtain other pieces for the museum eventually, if you wish. I presume that collecting these items for a museum is allowed under the laws governing their removal? The prospectors usually keep the pieces they find as curios, and some will be willing to part with them. Although I do not have reason to visit the goldfield often, now that our local "nickel boom" is over, sometimes I meet one or other of the prospectors when they come into Tennant Creek. I like to think that the practice of smashing the pieces up will cease from now on, seeing the word has got around that they are meteorite fragments and don't have gold nuggets in the middle.

I hope the above information will be useful for your records. Please call me if you wish to find out more about the occurrence, and I will be pleased to help if I can.

Yours faithfully,



Peter Simpson
Exploration Manager

Mr Peter Simpson
Exploration Manager
Giants Reef Mining N.L.
1/26 Irvine Street
TENNANT CREEK
NT 0860

25 June 1997

Dear Peter

I have just returned from overseas to find your letter of 28 May.

Thank you very much for taking the time to provide such a comprehensive account of the discovery and analysis of the Kurinelli meteorite fragments. A similar occurrence was found in the 1970's at Gove (NT) where a deeply weathered iron meteorite was discovered buried in bauxite. The Kurinelli fragments bring the total number of 'fossil' (if I can call them that) meteorites known from Australia to two, both from the NT.

From your description, I think that it is likely that the fragments represent the disintegration and distribution with time of a single (perhaps sizeable) mass of iron. Although as you suggest there is also the possibility of a crater-forming event. What is very interesting is the mode of weathering which suggests that the process of oxidation was extremely slow.

By pure co-incidence, currently we have Dr Phil Bland visiting us from England. Phil is here on a Royal Society Travelling Fellowship to do collaborative work with me on meteorites from WA. One of our main interests is the weathering of ancient meteorites in generally arid environments. Phil has been using Mössbauer spectroscopy to look at the nature and amounts of different oxidation products in old stony meteorites. From their state of oxidation and their terrestrial ages we hope to gain some insight into palaeoclimatic conditions during their terrestrial residence. I enclose a review paper that touches on the subject.

Neither of these occurrences (Kurinelli and Gove) has been described in the scientific literature, and I am keen to see that they are recorded correctly. With your permission I would like to forward the details of the Kurinelli discovery to the Nomenclature Committee of the Meteoritical Society. This is an international group which acts as the governing body for the naming of new meteorites. Naturally, you will be recorded as the source of the information.

I believe that the NT has legislation covering meteorites that is similar to that in

WA. I know the Curator of Geology at the NT Museum in Darwin, Dirk Megirian, well. Again with your permission, I would like to forward a sample to him for the Territories collection after the meteorite has been described.

I will keep you informed of developments. If any further samples turn up I would suggest that you forward them to Dirk Megirian at the NT Museum.

I also enclose some reprints of recent work we have done that may be of interest to you.

Thanks once again for your help.

Yours sincerely

Dr Alex Bevan
Curator of Mineralogy and Meteoritics
Department of Earth & Planetary Sciences

P O Box 1351
Tennant Creek
NT 0881
Ph 8962 2790

Friday 10th October 1997

to Dr Dirk Megirian
Curator of Geology
Darwin Museum & Art Gallery
Conacher Street,
Fannie Bay NT 0820

Dear Dr Megirian,

re Kurinelli meteorite fragments

You may have heard from Dr Alex Bevan in Perth of the Kurinelli "fossil" meteorite fragments that have been turning up on the Kurinelli goldfield, located about 150 km southeast of Tennant Creek.

Enclosed are copies of the petrographic reports that I sent to him in May this year, together with a copy of my letter which was to give him a little background to the occurrence. Also enclosed is a small piece of the meteorite.

I am aware that you are away on study leave until the middle of January, but I thought I would send you this fragment now rather than wait around and perhaps forget to do it.

The enclosed piece has been donated to the Museum by local Kurinelli prospector Mr Tony Campbell, who has worked on the Kurinelli goldfield for many years, and has found a number of meteorite pieces there. This one comes from (approximately) AMG map ref. 7710800mN 509700mE (Lat. 20° 6.7' Long. 135° 04').

One thing Mr Campbell told me is that all the chunks found so far have come from depths of half a metre to a little over one metre. He says that they have all been found by bulldozer scraping of the surface after their positions have been found with a metal detector. He is not aware of any pieces being found on the natural surface, although some have been left behind at the surface after the prospectors have dozed the heaped-up dirt back over the scraped areas. I was not aware of this point when I wrote to Dr Bevan. They appear to occur over an area about 2km in diameter, but this could change as more is learned about the area.

I hope to have rounded up a few more specimens for the Museum by the time you return from leave. Perhaps we can get in touch then.

Yours faithfully,


Peter Simpson



ROGER TOWNEND AND ASSOCIATES CONSULTING MINERALOGISTS

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Tony Martin,

1-4-98

Helix Resources NL.

1 Havelock St,

W Perth WA 6005

(These sections, previously examined and reported on by MINTEK, were lent to Helix Resources out of general interest. Helix's petrologist (Townend + Assocs.) wrote this report. JBS 28/5/98)

our ref. 98108

EXAMINATION OF ONE COVERED THIN SECTION AND ONE POLISHED SECTION.

The slides were labelled KURINELLI METEORITE 0531.

The slide and section show the rock to be composed of GOETHITE, MAGNETITE/MAGHEMITE, and QUARTZ mainly. Within the magnetite, there are occasional concentrations of fine to very fine inclusions of a bright metallic material, identified (SEM) as nickel bearing metallic iron. The relatively low nickel level suggests the alpha form, KAMACITE. The magnetite was also found to be nickeliforous.

The main textures are coarsely grid-like and with the extent of secondary goethite resemble coarse boxworks of the quadrangular type, quite similar to that derived from chalcopyrite. The magnetite is also present as clusters of sub 50 micron loosely attached octahedra in silica filled zones between the grid walls. It is not a spinel or Widmanstätten structure, although the thin section at low magnification does show some coarse octahedral structures. The common sulphide in meteorite, troilite, is a hexagonal mineral that rapidly oxidises to magnetite in the earth's atmosphere.

The silica in the thin section is present as QUARTZ and length fast CHALCEDONY. These are interpreted as forming under terrestrial conditions.

The very high iron content of the sample would be characteristic only of an "IRON" type. These are reported to be mainly composed of metallic iron with much lesser amounts of troilite etc. They display the well known octahedral Widmanstätten texture.

103-105 Dowd Street, Welshpool, Western Australia 6106

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COMMENT

NiFe is found, although rarely, terrestrially. It occurs in basalts where in contact with reducing sediments, in carbonaceous sediments, and in serpentinised ultramafics. According to Ramdohr (1969) the terrestrial iron lacks Ni, but later authorities (eg Craig and Vaughan 1981, and Anthony et al 1990) report the presence of Ni.

Information on Ni in magnetite is not readily available in standard texts, ie a search of journals is required. Trevorite is a rare Ni Fe spinel, found in ultramafic rock, with other Ni rich species. The recorded and theoretical values for NiO 20-30%, seem well above that of the present sample. In addition, the pink colour in reflected light is atypical of trevorite.

Ni oxide values noted from magnetites in terrestrial ultramafic rocks were 0.5% for Eastern Goldfield ore bearing material, and 1.1% in Ni laterite, from India.

The writer concludes that the sample is more likely to be a part oxidised meteorite, because of the common association of NiFe and (Ni)Magnetite in them, and the extreme rarity of the same pair in terrestrial rocks. In addition, the other minerals that make up the lithological types associated with NiFe on earth are entirely lacking.

The above is qualified by the writer admitting to negligible exposure to meteorites under the microscope. It must also be pointed out that volume of meteorites studied in academia, compared with magnetite bearing terrestrial rocks is negligible, ie statistics or data bases on the former are far from comprehensive. Nevertheless it may be worthwhile, if not already carried out, to probe the alloy and magnetite and plot them with the relevant values from meteorites and terrestrial samples.

R Townend



